111079

JPRS-UMM-84-002

13 February 1984

USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

FBIS FOREIGN BROADCAST INFORMATION SERVICE

13
48
AØ3

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS-UMM-84-002

13 February 1984

USSR REPORT

MACHINE TOOLS AND METALWORKING EQUIPMENT

CONTENTS

 [III - USSR - 36b]

ROBOTICS

MODERNIZATION OF VOLZHSKIY PLANT DISCUSSED IN DETAIL

Moscow MASHINOSTROITEL' in Russian No 7, Jul 83 pp 6-7

[Article by A. Klyukin, director, Volzhskiy Abrasive Plant: "All Attention to the Technical Improvement of Production"]

[Text] The Volzhskiy Abrasive plant specializes in the manufacture of grinding materials and abrasive tools from corundum and silicon carbide with a ceramic binder.

The plant's collective pays the closest attention to the full assimilation of its projected capacity, to raising the productivity of labor and the quality of the goods produced, mastering the manufacture of new products, mechanizing and automating technological processes. At the present time the plant is operating at full capacity, in fact, the original capability for smelting silicon carbide lumps has been bettered by 25 percent. In the 10th Five-Year Plan period per capita productivity for the enterprise as a whole grew by 23 percent. Above-plan output amounted to 8.9 million rubles. Forty percent of the plant's products bear the state Emblem of Quality. Technical retooling allowed us to put out an additional 7 million rubles' worth of goods. For these achievements the plant was awarded the Emblem of Honor.

These successes were made possible by putting into operation the most advanced technological processes and the newest product types, as well as by the mechanization and automation of production processes. The level of mechanization and automation in the manufacture of abrasive tools is far higher than at many of the industry's other enterprises.

The processing of primary materials for the production of binders and the making of the binders themselves are accomplished on mechanized flow lines. Semiautomatic pastemaking machines are used to prepare abrasive pastes and highly productive molding equipment to mold grindwheels. All transport operations are carried out by push-type suspension conveyers with automatic distribution which are integrated with the technological machines. This is of great help in the matter of achieving full mechanization and automation of production.

During the installation, launching and trial operation of new production and mechanization equipment many shortcomings were discovered. These were eliminated with the help of the Volzhskiy subsidiary of VNIIASh. Our own

Mechanization and Automation Department modernized a 315 ton/cm press. It now works in the automatic mode and at double its former productivity. The All-Union PA "Soyuzabraziv" has instructed that such presses be installed at every one of the industry's enterprises.

A 100 ton/cm press was refashioned by the plant's own staff into a semiautomatic machine to make whetstones for honing scythes. With manual weighing of the paste and its manual insertion into press molds the operator could make 700-800 bars per shift, now she does 3,000-3,500 bars.

The Mechanization and Automation Department redesigned a DB-24-32 press into a machine for molding grindwheels up to 300 mm in diameter. The paste is injected by "pneumatic blast." This led to a 15 percent increase in productivity compared to manual handling and a 2 percent reduction in the consumption of materials.

Operating in the molding section is an automatic production monitoring system. With its introduction machine stoppage has been cut 15 percent, it is now easier to find the on-duty mechanic or electrician whenever equipment failure occurs in the molding or pastemaking sections. At shift's end the machine produces a tabulated printout indicating the number of discs molded by the worker on the press, the number and duration of work stoppages and the person responsible for each. The printout covers the work of both production-line and auxiliary workers and serves as the basis for computing their wages and bonuses. A similar system of production registration has been put into operation in the abrasive-wheel machining shop.

The mechanization and automation of production has over the past few years led to the freeing of the equivalent of 500 workers. The proportion of mechanized labor plant wide now stands at 70 percent, in loading and unloading operations it comprises 98.6 percent.

Much has been achieved by the plant in recent years. Thus, it was the first in the industry to master the production of abrasive discs 750-1,060 mm in diameter out of type 91A multialloy corundum. Once convinced that the operational parameters of the new grinding tool were far better than was previously the case, we embarked on its industrial production. We also mastered the making of 500 mm grindwheels out of 93A and 94A corundum for centerless grinding. The successful organization of the production of composite-profile abrasive tools resulted in substantial savings for the national economy since they are 3-4 times cheaper than imported tools.

Together with the Volzhskiy subsidiary of VNIIASh we organized the production of high-geometric precision grindwheels (class A and AA). To this end a technological process was developed for machining them with diamond tools, new machine tools and equipment were acquired and existing ones modernized.

The mixing and molding machines underwent reconstruction as well as the tunnel kilns where the thermal and hydraulic regimes for the heat-processing of grindwheels were automated. The inner and outer diameters of the grindwheels were formerly processed in two consecutive operations on different machines, whereas

now this is done simultaneously on a machine tool designed by the institute and made by the plant.

These and other measures greatly improved the quality of the abrasive tools produced, so much so that they were all officially certified as top-quality goods. The plant produces 15 types of GOST-approved silicon-carbide abrasive materials which differ from each other according to the size of the main fraction's grain. The classification of abrasive materials by grain size is mandatory for the production of abrasive tools and when grinding with loose grains. In the manufacture of fireproof silicon-carbide products, though, many client plants resort to mixing a variety of granularity ratings (from 1,600 to 63 mcm) to achieve greater granular density. This reduces the acidification of the silicon carbide and correspondingly improves the durability of the finished product.

Working jointly with the institute, the plant mastered the technology for producing a composite silicon-carbide fraction with grain size up to 3,000 mcm for the porcelain and metallurgical industries. Their use led to a reduction in usable-material losses, the elimination of sieve installations and to better working conditions.

The operational properties of grindpaper depend to a very large extent on the shape of the grain. Abrasive grains with acute angles (nonisometric grains) have a high cutting capability.

The production of such materials has been mastered by the plant, and a new method of crushing silicon-carbide lumps has been developed. This entailed the complete reconstruction of the microgrindpowder shop. We now make micropowders from black silicon carbide that go into the production of water-repellent grindpaper.

After replacing the smelting furnaces, switching to high-power transformers, automating the charge-mixing operation and the regulation of the smelting process the plant produced an additional 3,500 tons of silicon carbide for the year.

At the recommendation of the Uzbek SRI for Energy and Automation of the UzSSR Academy of Sciences the plant incorporated into production a new method of smelting by preset active power, which led to a yearly savings of 6.5 million kWh of electricity.

The plant has not, however, brought every available reserve into play to raise the productivity of labor.

Unfortunately, the tools most commonly used by quality controllers of the Technical Control Division are the calliper and the ruler since there are no instruments in existence for a quick and thorough check of a disc's geometric parameters. This is a problem that we plan to resolve jointly with the Volzhskiy subsidiary of VNIIASh with the creation of mechanized flow lines to process and control 750-1,060 mm grindwheels, lines where a maximum number of operations will be combined. Inbuilt into the flow line will be a special

machine to regulate the geometric parameters of the discs which will eliminate manual labor by quality controllers.

In the next few years we intend to master a number of new products that the national economy has need for. A special shop for the manufacture of carborundum slabs is being erected at the plant.

The processing of intricately-shaped parts with the aid of specific fillers has become very important in recent years. A decision has been taken by the plant to build an abrasive-fillers shop.

In addition to all this we devote much attention to the social development of the collective, to the creation of favorable conditions for both work and rest. The plant has its own tourist base and Pioneer camp and recently completed a sanatorium-prophylactorium where our workers receive medical treatment without taking time off from their jobs.

The plant met its 1982 target figures ahead of time. Above-plan production of abrasive tools amounted to 1.3 million rubles, consumption of electricity showed a savings of 6 million kWh. In the third year of the current 5-year plan, the plant is working equally successfully. Above-plan output for the first quarter was 200,000 rubles.

12258
CSO: 1823/31

HIGHLIGHTS OF RIGA CONFERENCE ON EFFICIENCY, QUALITY IMPROVEMENT

Moscow MASHINOSTROITEL' in Russian No 7, Jul 83 pp 11-12

[Article by E. Ya. Freylibs, deputy chairman of the Latvian republican NTO Mashprom, L.N. Shliakhter and Yu. Yu. Poleschuk: "Improve Efficiency of Production and the Quality of Output"]

[Text] In October 1982, the Latvian republic board of NTO Mashprom [Scientific and Technical Society for the Machinery Industry], the Economics Institute of the LaSSR Academy of Sciences, the Latvian NII [Science and Research Institute] for Scientific and Technical Information, and the Riga division of VNIIS [Science and Research Institute for Standardization] hosted a seminar devoted to "Problems of improving efficiency and quality at machine-building plants." The seminar was attended by specialists from VUZes, the branch science and research institutes and KB [design offices], as well as industrial enterprises and associations of the nation.

In his opening statement the director of the Economics Institute of the Academy of Sciences LaSSR, Professor I. Kh. Kirtovskiy, doctor of economic sciences, said that much significance is attached in the republic to increasing the efficiency of production and the quality of the goods produced. The object of this particular seminar is to find the most effective ways of resolving the problems that arise in the course of putting into operation the "Republic system of product-quality control in the Latvian SSR."

Particular attention was paid in the reports and speeches of the participants to such central issues as perfecting the economic mechanism in machine building; improving the industry's performance in the matter of utilizing resources; developing quality-control systems; assessing and stimulating the quality of the product and of the work process; introducing the brigade form of work organization and remuneration.

Having established in his report that an objective evaluation of industrial enterprises' performance is a necessary prerequisite for the smooth functioning of the economic mechanism, Doctor of Economic Sciences Yu. V. Bogatin went on to note that there are two basically different approaches to the problem: a system of indicators is developed which reflect all the diverse activities of an enterprise; one single albeit synthetic indicator is instituted. The second approach is more progressive but a much more difficult one.

Elaborating, the speaker proposed that an indicator called the Comprehensive Plant Performance Evaluation Indicator (KOD) be used which reflects: growth in the volume of goods produced, fulfillment of the product shipment plan, a rise in the level of quality, improvements in the product structure and timely termination of production of obsolescent goods, expansion and better use of the plant's production facilities, acceleration of scientific and technical progress at the plant, continuous improvements in the organization of production, the work process and the management system, which must insure the utilization of all production and financial resources, significant reductions in every kind of environmental pollution, the cutting down of losses and costs in the process of transporting finished products to the client; a decrease in the maintenance, warranty and minor repair as well as operational costs run up by the user of the product. The KOD indicator has been operative these past few years at several machine-building plants, with positive results.

G. Ya. Rubin, candidate of economic sciences, pointed out in his report that the interrelationship between KS PEP [Comprehensive System of Economic Production Indicators] and the economic mechanism of the enterprise manifests itself in two ways. During its development and assimilation stage the system plays the role of a method to improve the economic mechanism, it is the carrier of a complex of elements which comprise a substantial part of that mechanism and which determine the top priorities of the improvement process. After assimilation and as it gains operational momentum it becomes a reliable organizational, methodological and ideological basis for perfecting the economic mechanism of the enterprise.

At the present time the planning and stimulation of accelerated scientific and technical progress (NTP) is based on a system of progressive norms which take into account the interrelationship between the costs of implementing specific NTP measures and the results of their assimilation into production. Professors V. P. Khaykin and V. V. Mamonova proposed that mathematical statistics methods be applied to compute these norms with the results being presented as correlational norms or formulas. This insures the stability and dynamism of the normatives which are especially important in a period of ever-accelerating scientific and technical progress. The introduction of a normative base for the planning and stimulation of NTP will enhance the validity of science and technology plans.

I. Kvedaravicius and V. Zilinskas, candidates of economic sciences, spoke about ways to optimize outlays in developing an industrial product. An important role in this regard belongs to a method called functional cost analysis (FSA) which correlates the functional usefulness and optimal quality of a product with minimal expenditures on its development, manufacture and exploitation. The method is currently being used at the industrial output stage of products developed earlier.

The report of K. J. Svilpe, candidate of economic sciences, dealt with the problem of distributing bonuses among work team members. The method proposed insures that all have a vested interest in improving the quality of their labor, both individual and collective. Special formulas and coefficients

are used which gauge the worker's contribution, his initiative and the quality of his labor.

Speaking on the subject of reducing materials-intensiveness of machines through standardization, L. B. Sul'novar and V. I. Bubnov, doctors of economic sciences, noted that the qualitative parameters of all products, including materials-intensiveness, are set during the design phase. That is why GOST 15.001-73 should either be amplified and reworked or a new special standard should be developed spelling out the general principles of machine design. It would also be expedient to establish a number of organizational and methodological sectorial standards which would regulate the planned input of materials and other resources necessary to produce machinery of a certain level of quality. In addition to these sectorial standards it is also desirable to develop an intersectorial methodology that would allow measures aimed at saving materials plant and industry wide to be coordinated with the corresponding sections of the technical, industrial and financial plan and the sectorial plan. The proposed standards would thus play the role of a normative base orienting machine-builders toward high production and economic achievements.

V. A. Shvandar, candidate of economic sciences, reported on the development of a state standard to determine the economic effectiveness of unification of the machine-building industry's products. Since normative and technical documentation contains no overall indicator expressing the level of unification, the new standard uses three indicators to characterize the changes which that level undergoes at various points in time. These are the coefficients of product repetitiveness, interchangeability and interproject unification. Depending on the initial economic information available and the phase of the product's development, the author proposed a choice of two methods to assess any rise in the level of unification--the consolidated and the unit methods.

The report presented by V. V. Okrenilov, N. V. Kondratyev, candidate of technical sciences, and V. Ye. Shvets, candidate of economic sciences, made the point that one of the important preconditions for controlling quality is a comprehensive analysis and assessment of all the factors that influence the qualitative results of an enterprise's activities. One such experiment is being conducted by the machine-building plants of Leningrad where the technical and organizational levels of production (in particular, the technological processes, the quality of the equipment, raw materials, semifinished items and shop-floor organization) are regularly evaluated and certified. A set of instructions has been issued on certifying the effectiveness of the Comprehensive System for Regulating the Quality of Production. Improvement of the production quality and related factors certification system will increase the effectiveness of the overall quality-control effort.

L. A. Pupola, candidate of economic sciences, emphasized in her report that evaluating the quality of work done by branch NII and KB is aimed at stimulating the collectives to develop new machines with minimum investments and within a set time frame and a level of quality that conforms to modern standards and the achievements of NTP. The author has developed a point-coefficient formula for evaluating the quality of work performed by an institution's

collective. All individual indicators of job performance are categorized into three groups: the quantity and quality of the end results of research and design work, the material costs thereof and the quality of work organization. The normative values of the individual indicators and their relative weight coefficients are determined by a commission of experts.

Of note in the report by Ye. S. Vasil'yeva and M. A. Zvereva, candidates of economic sciences, were the following indicators of quality in the scientific endeavor of NPO [Science and Production Associations]: the quality of the product (its scientific and technical level, novelty, the degree to which the actual results approach the planned quality level, the time it takes to be assimilated, etc.); the effectiveness of NIOKR [scientific research and experimental design work] processes, (the number of inventions and publications, the incidence of complaints about the product, etc.); the fulfillment of socialist obligations (results achieved measured against the target figures, the level of fulfillment of the obligations); work with cadres (improvement of skills, participation in sponsorship activities, level of labor discipline, cadre turnover). The authors have developed a methodology to determine a comprehensive indicator of quality to evaluate the work of science collectives which is used to compute quarterly bonuses and determine the outcome of socialist competition between the scientific subdivisions of an NPO.

A detailed analysis of the criteria used to classify a product as top or first category quality was made in a report by V. G. Shteingauz, candidate of economic sciences. She proposed that only those products be rated top quality whose technical level and quality exceed the finest world standards or are on a par with them, that benefit the national economy, satisfy its needs and those of the population and are marketable abroad.

Many other reports also evoked great interest. After discussing the information, the participants worked out recommendations for improving the effectiveness of production and the quality of the goods manufactured by machine-building enterprises.

12258
CSO: 1823/31

PROGRESS IN CAD/CAM, AUTOMATED WORKSTATIONS REVIEWED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 25 Sep 83 p 2

[Article by M. Shkabardnya, USSR Minister of Instrument Making, Automation Equipment and Control Systems: "Computers Serve Engineers"]

[Text] The concept "flexible automated production facility" appeared quite recently in our lexicon, and it immediately became a kind of banner of technical progress for all machinebuilders. This popularity can be explained not only by the attractiveness of the very dream of a future plant freeing people of all difficult, exhausting labor and permitting the immediate, fastest possible utilization of scientific achievements. The concept of thorough, comprehensive automation which is the basis of this new type of production is already an urgent task.

The country's fleet of numerically-programmed metalworking equipment is being increased by tens of thousands of units annually. It is being supplemented increasingly intensively by robot equipment. Whereas upwards of 1,000 robots and manipulators appeared last year in our branch, for example, this year several thousand will appear, and the number will have risen to 30,000 in the five-year plan as a whole. These and other elements of automated production are being combined into integral-process technological sectors at many enterprises. The Petrodvortsovyy Watch Plant was retooled to a progressive technical base, permitting a nearly two-fold increase in labor productivity. Another two watch plants in Moscow are now being retooled in the manner of this enterprise. And the first branch flexible automated servo-mechanism gear production facility will begin operating in 1985, making it possible to increase output at least five-fold in the same premises and with the same number of workers.

These are gratifying changes. However, they are creating a qualitatively new situation in machinebuilding. It is becoming increasingly obvious that the forced development of the processing and assembly links of production is not an end in itself. We must also ensure the release of output whose indicators correspond to the best modern models. But it is precisely the development and mastering of such progressive items that increasingly often turns out to be a stumbling block for machinebuilders. In spite of the fact that the army of planners and designers in machinebuilding has been increased approximately 1.5-fold over the past 10 years, the time involved in developing new equipment has hardly been reduced at all. Not infrequently, expensive automated equipment

stands idle, as technologists are simply unable to prepare the necessary documentation and control programs in time. And the main problem here is inefficient planning-design work. Design bureau and production specialists have been overloaded with an enormous number of routine operations, on which they spend the bulk of their working time.

This disproportion in the availability of engineer and worker labor is forcing us to reject the previous approach, in which primary reliance was placed on production automation. The recently adopted CPSU Central Committee and USSR Council of Ministers Decree "On Steps to Accelerate Scientific-Technical Progress in the National Economy" poses the task of creating unionwide work programs for both flexible automated production facilities and automated planning systems. The necessity of developing and implementing such programs is all the more obvious in that it is no longer sufficient to have mastered the basic ways and means of automating engineering labor.

In recent years, upwards of 30 automated planning systems and subsystems have been introduced at instrument-making enterprises. They are radically changing the nature of the engineer's labor. One example would be the SAPR-TP, developed by branch specialists for planning machining technology. It is now in operation at the "Elektroagregat" production association in Novosibirsk, the "Aktyubrentgen" production association, and other machinebuilding enterprises. A technologist now needs only insert into the machine an encoded blueprint of a part, and he will obtain in minutes all the documentation necessary for its manufacture. The system automatically works out a route map with operational technology, determines and selects the blank required, determines the machining tolerances and dimensions, and selects the machine-tool model and all the tools needed.

Probably the most effective of the currently operating automated technological process planning systems is the "Avtoshtamp" SAPR. Whereas an average of about 130 hours is spent on planning one stamp using the traditional, manual methods, automation has reduced this process to seven hours. Today, an automated printed circuit board planning system which improves designer labor productivity approximately four-fold has been introduced at all ministry enterprises.

The impact of comprehensive automation is increasingly perceptible at the branch level. By 1980, we had succeeded in halting the growth in the number of specialists engaged in developing and mastering new equipment: their numbers are now stably decreasing by one to 1.5 percent annually. On the whole, the creative potential of our engineers has risen. This is borne out, for example, by the recently adopted "Quality" branch program. It outlines a significant rise in the technical level, quality and reliability of the output being produced, 1.5- to two-fold for the most important items. We will naturally be able to carry it out with the same number of specialists currently available to us.

Our branch plays a special role in automating engineering labor, as we are in fact the main developer of the equipment needed to do this. Currently, great efforts are being made to develop automated workstations (ARM) for designers and technologists. We recently accepted for series production a new system, the ARM-TP, developed for use with the "Iskra-226" personal computer. This automated programmer workstation reduces two- to three-fold the labor involved in preparing control programs for NC machine tools and ensures that they will be of high quality.

Already this year, we have orders from various branches for 50 ARM's, and their production will increase sharply thereafter; we will be able to fully meet the demand for them in the very near future.

But what has been done has been just the first steps. We have set ourselves the goal of comprehensively automating engineering labor. The reference is to creating systems which will encompass all stages of the planning, design and technological supply of production with machinebuilding items. The automated technological design bureau -- AKTB -- will be a significant landmark on this path. The range of its functions -- from automatic development of a rough drawing by the designer to the issuance of control programs for NC and robot equipment. Such an AKTB will be able to release its "output" both in the form of traditional blueprints and on magnetic information carriers in the form of microfiche or microfilm. We are already creating an automated workstation complex (modular and ordinary design) and developing equipment for machine representation of textual documentation and norm-monitoring equipment for it, to be used with these AKTB's.

One would think there is every basis for assuming that, in combination with automated control systems, precisely such automated technological design bureaus would comprise a foundation on which the concept of flexible automated production facilities could be actualized to maximum effect.

At the same time, we are well-aware that automating engineering labor is a big, complicated task. We need to ensure the standardization and interlinking of the available equipment and the development of new equipment. We are faced with substantially lowering their cost. We see great difficulties in organizing the software. Poor coordination of the branches and departments in solving this task is especially disquieting.

The list of problems in the path of automation is longer still. However, they all reduce in the end to one primary problem, the necessity of convincing both leaders of all ranks and the line specialists that automating the engineer's labor is not some distant dream, not a fad, but an essential task requiring priority attention. To support this idea, let me give just one example. The level of the equipment being developed, and foremost its reliability, ease of service and repair, are determined largely by the quality of the element base. We have long been unagle to achieve perceptible advances in this area. We have yet to break the psychological barrier. Specialists from the Ministry of Electronics Industry and our own ministry, following a unified plan, have now considerably increased the average malfunction-free service life of computer equipment. The next goal is to reach a level which fully meets the demands of automating even a continuously-operating production facility.

Flexible automated production facilities are a present reality. Quite understandably, their widespread use will require certain expenditures. We need first to ensure the outstripping development of those branches creating the technical base for automation. But these expenditures are quickly recompensed, and many times over. The CPSU Central Committee and USSR Council of Ministers Decree "On Steps to Accelerate Scientific-Technical Progress in the National Economy" determines the main paths of the scientific-technical revolution at

the present stage. One primary path is that of the comprehensive automation of production and engineering labor. And the thousands-strong collective of instrument makers is making every effort to successfully resolve this important statewide task.

11052
CSO: 1823/57

PROGRESS, SHORTCOMINGS OF MACHINE TOOL INDUSTRY VIEWED

Moscow AGITATOR in Russian No 17, Sep 83 pp 25-27

[Article by A. Skripnikov, deputy chairman of the USSR State Committee on Standards; material in boldface rendered in all caps]

[Text] The machine-building and metal-working industries are the largest and fastest growing sectors of our national economy. During the period of 1970 to 1972 production increased more than 2.8 times, while their share in the overall volume of the industrial production rose from approximately 20 to 30 percent. Additionally, this branch is developing at a rapid rate and increasing production output in the third year of the 5-year plan.

The great successes of the machine-building industry decisively determine the rate of growth of our economy as a whole, determine the technical reequipment of its branches, intensification of production, and increase its efficiency. In his speech at the June (1983) Plenary Session of the CPSU Central Committee, Comrade Yu. V. Andropov pointed out that a huge effort awaits us in the development of both contemporary and future machines, equipment and technologies. Production automation, the broadest possible usage of computers and robots, and introduction of flexible technologies which allow rapid and efficient reorganization of production to manufacture must still be realized. And, of course, it is necessary to reduce sharply the use of manual labor, first of all through full mechanization.

THE SOLUTION OF THESE PROBLEMS DEMANDS THE FAST DEVELOPMENT AND SOPHISTICATION OF ALL MACHINE BUILDING SECTORS, AS WELL AS A STEADY AND SIGNIFICANT INCREASE IN PRODUCT QUALITY.

The products of this industry that meet the requirements radically transform the labor conditions and efficiency for the users. Here there are a few examples.

The motor vehicle builders have created and mastered the production of a new automatic loader for containers with a 20-ton carrying capacity. Each machine of this class frees 30 workers from heavy manual labor and with rational use provides an annual savings of more than 10,000 rubles.

An automated computer run machine tool complex was developed at the Ivanovo Machine Tool Production Association imeni 50th anniversary of the USSR. Four

machine tools included in this complex are able to process parts of any complexity without human interference and are able to change independently tools or production modes as necessary. The finished parts are transported to the warehouse, also without assistance, where they are deposited in preassigned spaces.

In 1975 the machine builders produced only 120 automatic manipulators with program control or as they are colloquially, industrial robots. In 1980, production was already 1,579 units, about 5,400 in 1982, and at present, according to the plan, more than 7,700 units should be produced. As opposed to the typical rigidly programmed automated devices, robots can be reset rapidly and provide service as the technology changes. They successfully replace workers in metal-cutting, die-casting, welding and even assembling processes, allowing to eliminate manual, unskilled and monotonous labor as well as labor in difficult or hazardous to health conditions. For example, at the axle shop of the Kama Association for heavy truck production, the usage of robots at auxiliary operations for equipment loading allowed the replacement of about 100 workers. During this 5-year plan period, a total of more than 70,000 men will be released from manual labor with the help of the manipulators. And this is just the beginning. In the future, robots will be widely introduced into metallurgy, the light and food industries as well as others. Coal mines using them are planned without the constant presence of men underground.

The tractor builders of Minsk designed a new multipurpose MTZ-100 tractor-cultivator whose productivity is much higher than that of the machine manufactured earlier with material consumption lower by about one-fourth. The machine is equipped with a device for adjusting the depth of cultivation, and has a safe, airtight cab with an air conditioner.

Planned quotas, periodical revision of standards and wholesale prices impel the machine builders to cooperate with scientific collectives in order to develop, master production and increase the output of new progressive technical equipment. Its cost, especially at the beginning, is often higher in comparison to the cost of technical equipment produced earlier and this is taken into consideration by the current pricing structure. Moreover, in recent years, a great deal was changed in the pricing structure so that the new good technology would be economically profitable for the producers, provided with a greater profit and increase deductions for the economic incentive fund. At the same time a part of the gain from the new products should naturally go to the national economy and the consumers. For this reason, it is necessary that a unit of profit be calculated against technology whose cost and price is below the old one. Unfortunately, this does not always turn out to be the case at present, and we should not accept this. Machine designers and producers should think more about economical matters, decrease of the metal content and capacity of their products, and which should operate so that they are profitable both to industry and the consumers. In conclusion, machine builders like all the toilers should develop modern economic thinking, socialist enterprise and efficiency without any delay, as directly pointed out by the June (1983) Plenum of the CPSU Central Committee.

During the past half of the current 5-year plan, the machine builders, in creative cooperation with scientists, mastered the production of more than 2,500 advanced machines, equipment and instruments; also several thousand obsolete products were removed from the production. Hundreds of the enterprises in the branch produce more than half of their production with the State Emblem of Quality.

Among them, for example, is the GPZ-1 [State Bearing Plant] Production Association in Moscow. The bearings manufactured by the plant won worldwide recognition and are exported to 39 countries. Last year, the kharkov collective of the Ukrelektromash Production Association increased the output of the top quality production to 81.5 and now has pledged to raise it to 86 percent. The VEF Production Association imeni V. I. Lenin in Riga decided to deliver 93 percent of its consumer products with the State Emblem of Quality during the 3d year of the 5-year plan.

NEVERTHELESS, IN THE MACHINE BUILDING INDUSTRY AS A WHOLE, PRODUCT QUALITY IS STILL FAR FROM MEETING THE HIGH REQUIREMENTS OF TODAY. At many enterprises the production share of the highest category products is very small, and three-fourths of the enterprises have none. The design and development of modern machine-tools and some other machines proceed slowly, and often when series production is begun, these lag behind the best world models. The rate of growth of new equipment output is often insufficient, and this delays replacement of obsolete and worn out equipment.

Sometimes, the enterprises surrender even the achieved positions, reduce production quality, including that of products that earned the State Emblem of Quality, losing it sometimes before the appointed time or at the next recertification.

A part of the production is obviously obsolete; it is either certified as second-grade or not certified at all. Requirements for removing the obsolete equipment are not carried out systematically. Last year, Minavtoprom [Ministry of the Motor Vehicle Industry], Minergomash [Ministry of the Power Machine Building Industry] Mintyazhmash [Ministry of Heavy Machinery Manufacture], Minelektrotekhprom [Ministry of Electrotechnical Equipment] and some other machine building ministries removed from production only 63-89 percent of obsolete technical equipment. The share of such equipment (produced 10 years or longer) in the total production volume of 11 machine building ministries rose from 16 percent in 1967 up to more than 30 percent in 1981.

Quite rightly, consumers protest that the quality of many machines doesn't meet the requirements. The opinion of M. Reshetnikov, Hero of Socialist Labor and notable brigade leader of the Zyryanovskaya mine, Yuzhkusbassugol' Production Association is an interesting example in this matter. His view is interesting in particular because he highly evaluates the mechanized OKP-70 breakage face complex, which is being manufactured by the Kran Association of Uzlov. "Nevertheless," writes the coal miner, "even this outstanding piece of equipment has design shortcomings, which we have mentioned and written about many times in our letters to the machine builders. Unfortunately, for some reason they are not in a hurry to correct the faults. So we must rebuild or improve

them semiprimitively ourselves in our own machine shops. I think the machine builders should take our propositions and requests into consideration.

Many complaints of such type come to the press, departments, or directly to the enterprises, especially concerning machines used under complicated conditions in agriculture, on construction sites, at timber operations, etc. Often, clear deviations from standards or specifications come to light as a result of consumer complaints and work checks. This is simply wastage which the manufacturers had no right letting through the shipping gate. USSR Gosstandart and its organs take severe measures against such enterprises: they are not allowed to ship their products until everything is put in order, the cost of unfit products is excluded from the sales report, and profit from such products is transferred to the state budget. This hurts the producers of defective goods materially but apparently not strongly enough.

Consumer goods need special mention. Many models of refrigerators, washing machines, TV sets, vacuum cleaners, cameras and other consumer items lag far behind the best foreign and domestic samples. For instance, three-fourths of the produced refrigerators have a far too small capacity, and excessive power consumption. At present, USSR Gosstandart has approved a change in the existing code for home refrigerators which provides a considerable reduction (to 40 percent) in specific power consumption.

The design quality of the machine building industry products is determined to a decisive degree by the work quality of scientists and specialists in the enterprises. However, ordinary workers as well can influence quality through efficient proposals, and through the establishment of an intolerant attitude to the production of obsolete goods within the collective.

As far as performance quality of machines and other products, it can be stated that, already it first depends precisely upon the ordinary toilers, their qualifications and proficiency, diligence and conscientiousness. For example, the Heroes of Socialistic Labor, Valentin Grigor'yevich Semenov, mechanic brigade leader of the Podel Mechanical Plant imeni Kalinin; Vladimir Stepanovich Chicherov, brigade leader of the mechanic-assemblers of the Leningrad Metallurgical Plant Production Association, who recently became the twice Hero of Socialist Labor; Alexander Grigorevich Bardin, grinder at the Frezer Plant in Moscow, and other machine builders are setting brilliant examples of a communist attitude to labor.

Conscientious workers do not run after quantity to the detriment of quality but skillfully combine both. However, machine building products are usually the result of the activity of tens, hundreds and even thousands of workers. And let just one of them deviate from the design, disrupt the operation or mix up the assembly due to carelessless, hurry, or due to hangover, and the work of many people goes to pot, and the result is an evident or concealed damage, one that will be discovered by the consumer.

Unfortunately, such things happen rather often at present, as a result of which consumers suffer great economical losses and struggle with endless adjustments and repairs of a combine, TV-set or other product which is not

bad and even very good in design but worthless in manufacture. Such practices cannot be tolerated as they are both wasteful and amoral. They should be decisively combatted with both educational and economical measures, not on paper but implementing actual comprehensive quality control approaches, including systems for defect-free manufacture and for the first time delivery. Also, conscientious workers should be provided with moral and material incentives, while bad workmen should be penalized with the ruble as well.

Thanks to such measures at the earlier mentioned State Bearing Plant, first time delivery was brought almost to 97 percent. The collective of the Berdyansk Road Machine Plant pledged to improve this number in the current year up to 99.4 percent. Hundreds of thousands of Sverdlovsk Oblast machine builders are working using the defect-free manufacturing system. In other words, there are examples to follow.

In the current year, plans are to put into production about 4,000 types of new machines, equipment and instruments, to stop production of 1,500 outdated items, to increase the share of top quality production within the overall volume of the machine building production up to 39.5 percent. The tasks are complicated but feasible for the machine builders, and they must be successfully resolved.

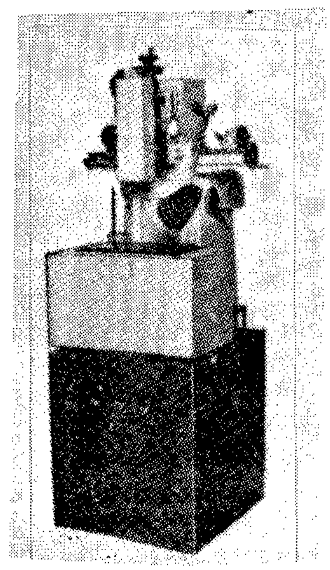
12563
CSO: 1823/42

UNIVERSAL, TRACER-CONTROLLED EDM MACHINE

Moscow EKONOMICHESKAYA GAZETA in Russian No 36, Sep 83 p 23

[Article under the heading: "Troitskiy Machine Tool Manufacturing Plant Offers"]

[Text] The 4G721M general-purpose electro-erosion duplicating piercing mills for machining parts made of high-strength current-conducting materials -- refractory, hard, magnetic and other special materials, as well as tempered and high-alloy steels.



It enables us to work parts which can be machined only with difficulty, if at all, using traditional cutting methods.

Its versatility permits various operations such as making small holes, narrow slits of complex configurations, and grids; engraving; removing tool (drill bit, tap) cuttings; manufacturing and repairing stamps; slitting lightgage blanks.

The machine has replaceable attachments (electromagentic vibrator, arbor, crosscutting device, collet and articulated chuck, prism), which increases its technological versatility.

The system for pumping the working fluid in and out has filters for cleaning fine erosion-process particles from the dielectric fluid. A heat exchanger lowers the temperature of the working fluid. No special base is required; it is sufficient to mount it so that industrial water can be supplied. The technological current is supplied by a broad-band ShGI-40-440B (ShGI-40-440A) pulse generator.

Basic machine-tool data: worktable surface -- 200 x 360 mm; largest parts which can be worked -- 320 x 190 x 130 mm.

11052
CSO: 1823/47

OTHER METALWORKING EQUIPMENT

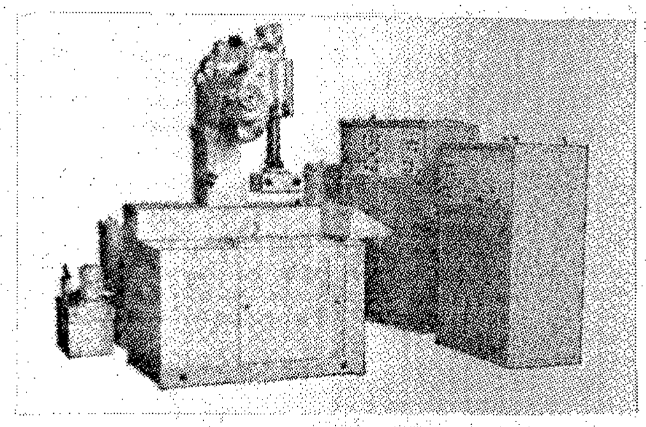
MULTIPURPOSE, TRACER-CONTROLLED EDM MACHINE

Moscow EKONOMICHESKAYA GAZETA in Russian No 36, Sep 83 p 23

[Article under the heading: "Troitskiy Machine Tool Manufacturing Plant Offers"]

[Text] The 4Ye723 electro-erosion duplicating piercing mills for working refractory and hard alloys, stainless steels and other current-conducting materials of any hardness or ductility which are hard to machine using ordinary mechanical methods.

The machine is used most often to make forging, bending and punching stamps, press-molds, chill molds, draw plates, vanes and impellers for gas-turbine engines, grids, flutes, slits, through and blind holds, and so on.



Provision of the machine with replaceable attachments (orbital diehead, single-circuit adapter, fittings adapter) increases its versatility.

The machine requires no special base; one need only anticipate access to industrial water and exhaust ventilation when installing it.

The working current sources are a broad-band ShGI-63-440 pulse generator and a TG-250-0.15M generator for roughing out.

Basic machine-tool data: worktable surface -- 400 x 630 mm; nominal machining area -- 25,000 mm^2; heaviest part which can be worked -- 750 kg.

11052
CSO: 1823/47

AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

INDUSTRY MINISTER LINKS FUTURE OF FMS TO COOPERATION WITH CEMA

Moscow IZVESTIYA in Russian 1 Dec 83 p 2

[Interview with B. V. Bal'mont, Minister of Machine Tool and Tool Building Industry, by B. Konovalov, under the heading "Mainlines of Scientific-Technical Progress": "Production Acquires Flexibility"]

[Text] [Question] Boris Vladimirovich, we now have a new term, "flexible manufacturing systems." A new direction is taking shape in machine tool manufacturing. Tell us, please, about its features. What has caused its appearance, and what opportunities does it open up before other branches? Machine tool manufacturing is, after all, the heart of all machinebuilding, and its level depends largely on the capabilities and productivity of machine tools.

[Answer] Automation is the mainline of development in any branch of our national economy. The party has posed the task of increasing output with a reduction or at the least a stabilization in the number of workers. At a January meeting with Moscow machine tool builders, Comrade Yuriy Vladimirovich Andropov stressed that "increasing production efficiency is our primary path." Our ministry is therefore increasing foremost its production of automated machine tools and those with numerical programmed control, of automatic and semiautomatic lines. Their use is very advantageous in mass production for output which does not change for a number of years.

Scientific-technical progress in many branches has necessitated more frequent changes in the production of particular machines and mechanisms, generating new developments which are less materials- and energy-intensive and whose specification are better. Mastering their production demands technology permitting rapid retooling. Thus was generated a new demand of the times on the machine tool pool, a certain "production flexibility," an ability to changeover rapidly to the release of new output. In principle, multipurpose machine toold previously ensured such flexibility. But they require highly skilled workers, of whom we currently have a scarcity. And it is now mandatory that production flexibility be combiled with the automation of technological processes. This has been another factor in the rise of flexible manufacturing systems, which have now become one of the primary directions of scientific-technical progress in machinebuilding.

It must be emphasized that flexible manufacturing systems are only one link in the comprehensive automation of production. Their use will yield maximum impact only when the whole chain of birth of a new product -- from embodiment of

the concept in technical documentation to release of the finished product -- is automated. This chain must be begun with automated design systems using computers, to sharply increase the labor effectiveness of the design engineer, estimator and technologist.

[Question] And what is your ministry doing along that line?

[Answer] Our lead organization, the Experimental Scientific Research Institute of Metal-Cutting Machine Tools (ENIMS), has set up close cooperation with ten design bureaus and plants in the ministry to develop various automated design systems for the branch. For example, a computer is used to automatically design one of the main subassemblies of standard-unit machine tools and automatic lines, spindle box units, which house the machining tools.

Traditionally, a designer would spend up to 20 working days on calculations on and the development of technical documentation for a spindle box. Using programs in a computer memory, this work is now done in two hours. When computers are used, flow charts essentially become unnecessary. The ENISM computer center sends the "Stankoagregat" plant a punch-tape for the machine tools with numerical programmed control produced by our branch (in this particular case, the Moscow Plant imeni Ordzhonikidze), which manufacture the basic spindle-box parts. If a new box is needed, the punch-tape is changed, and it is done. That is production flexibility. The machine tool is manned not by a highly skilled worker, but by an operator, who only monitors the machining process. Obviously an automated system, but it still requires the presence of workers. If a machine tool is equipped with robots to feed the blanks and take the finished parts from the machine tool, and with a robot-car to take them to a storage area for finished parts, then the system could also operate strictly automatically.

[Question] Are those only plans, or are such systems now in operation? When does the ministry intend to begin the series production of flexible manufacturing systems?

[Answer] Much is still in the rough-draft stage, of course, but the first steps are being taken along this line, and we are working to make them concrete and practical. The route we plan to take is to develop flexible automated modules, each with its own "specialty," which can be combined into any desired line needed by any given production facility.

The flexible production module consists of a machine tool and adjacent equipment, including the table on which the blanks being machines are placed, the industrial robot feeding the parts and removing them after machining, and also the mechanisms for replacing the tools. All these devices will be computer-controlled.

It seems to us that the first generation of such modules would have to be "loaded" and programmed to operate with operator assistance, but that the second and third generations could operate automatically. This would have an enormous impact on the country's economy, as there are currently not enough labor resources for machinebuilding enterprises to operate around the clock.

About 60 flexible manufacturing systems are already operating at various enterprises in our country, and some experience has been accumulated. We plan to

produce foundry, foreg-press and various metal-cutting flexible automated modules. Thus, the "Krasnyy proletariy" plant in Moscow must set up the series production of lathe modules for machining lightweight parts, the Ryazan plant -- heavy parts, the Kharkov Plant imeni Kosior -- grinder modules, and the Gorkiy plant -- milling machine modules. A number of enterprises are setting up the production of milling-boring machine modules based on "processing center" type machine toold. They will be produced in Ivanovo, Leningrad and Odessa. The mass production of industrial robots is being set up at the "Krasnyy proletariy" plant and the Sterlitamakskiy Machine Tool Manufacturing Plant.

The "Stankoagregat" plant in Moscow has manufactured an adjustable automatic line for the "Kompressor" enterprise. This enterprise needed seven types of compressor housings, but in small lots of 20,000 to 50,000 units. An analysis showed that one adjustable automatic line would be appropriate to their production. On it, multispindle heads machine the housings, replacing one another in sequence. Inasmuch as many tools are operating right away, this line is productive, and its "adjustment" takes only about an hour.

This is also essentially a flexible technological module, but a more complex one. We think that, by creating a whole gamut of flexible automatic modules, sectors and lines, we will be able to meet the requirements of any branch, and foremost of machinebuilding, which is of pivotal importance to the national economy.

[Question] What difficulties stand in the way of this new equipment? What problems, in your view, must be solved first?

[Answer] The role of automata is extraordinarily greater in this new equipment. It would be extremely inefficient to develop our own electronics and electrical engineering subbranches and embark on organizing an in-kind economy. The only intelligent course is broad cooperation with those ministries which have long specialized in this area. We have now drawn up plans for joint work with the Ministry of Instrument-Making, Automation Equipment and Control Systems and the Ministry of electrical Equipment Industry, which are to supply us with assembly components. Cooperation within the CEMA framework is planned. And the development of flexible manufacturing systems and their quality will depend largely on the effectiveness of this extensive cooperation.

Flexible, automated production systems must be extremely reliable so as to yield the planned impact and operate two and three shifts without human participation. And in this respect, every assembly component takes on important significance, because any malfunction by it could stop the whole system. We are all faced with doing a great deal to ensure the highest possible reliability of the new equipment. This is our most critical problem today, and its solution depends largely on related suppliers. We must receive assembly components at the most modern technical level, meeting the needs of machine tool manufacturing, and foremost effective control systems for flexible production facilities.

[Question] On what principles will the interaction with client ministries be set up? Their role will, after all, be an important one in this new work.

[Answer] Unquestionably. It must be emphasized that the use of flexible systems requires a new method of organizing all production, especially in the area

of technical preparation, tool economy and servicing complex automated equipment. It is simply inconceivable that this task can be resolved without the participation of technological planning and design organizations and enterprises of the consumer ministries themselves.

Flexible, automated manufacturing systems are very expensive and must be used where most appropriate, where they will yield the maximum economic and social impact. They are by no means universally required. Everything depends on the nature of the production and its scale, the output being produced and the frequency with which it is changed. The extensive use of automata, machine tools with numerical programmed control and automatic lines has not lost its importance, as enormous areas of application remain for them. In many cases, traditional modern technology can be integrally combined with flexible technology. Flexible automated production facilities, individual modules which can ensure greater overall effectiveness, can be "built into" ordinary sectors and lines.

The new equipment must be integrated with existing automated technological production control systems. Many branches have already achieved major successes in this area. Automation needs to be created at all levels and penetrate the entire production cycle, from chief designer to each enterprise workplace.

We view as our most immediate task that of creating base flexible automated modules. But the branch client institutes, jointly with their own plants, must themselves shape the systems they need. This will require of workers in all branches a thorough knowledge of the potential of series-produced modules and their skillful use. And this must be achieved without delay. Consumers must even now be preparing to restructure their own production and to plan ways of renovating. Tomorrow is born of today.

11052
CSO: 1823/69

STATE OF ROBOT TECHNOLOGY IN CEMA COUNTRIES REVIEWED

Moscow NAUKA I ZHIZN' in Russian No 10, Oct 83 pp 2-6

[Article by M. S. Shkabardnya, Minister of Instrument Making, Automation Equipment and Control Systems: "Robotbuilding. New Sector of Industry"]

[Text] Robotbuilding is a new word. However, it is time to get used to it, as in its time, we got used to word combinations "electronic industry", "nuclear machinebuilding" and "space technology." These days, a new sector is being born and specialized plants appear whose primary occupation is wide-scale production of automatic manipulators with programmed control -- robots; scientific and design collectives which investigate the new area of equipment, are being created. The specific comprehensive program for creating and assimilating industrial robots envisages the development and the start of manufacture, before 1985, of about 50 specimens of industrial robots, 38 complete sets of technological robots, and 17 automated shops and sections equipped with automatic manipulators. It is planned to organize the output of complementing products for robots, including programed control devices, specialized hydraulic and pneumatic equipment and sensors. An important part of this program is being implemented by the Ministry of Instrument Making, Automation Equipment and Control Systems where robotbuilding was made an independent sector. Last year, a specific comprehensive scientific technological program was developed in this sector, and is now being successfully implemented, to create and introduce robots, manipulators and complete sets of technological robots in 1982-1986. The content of this program and the problems in organizing robotbuilding are being told to N. Petrov, special correspondent of the NAUKA I ZHIZN' Journal by Minister Mikhail Sergeyevich Shkabardnya, doctor of technical sciences.

I recall the "Avtomatizatsiya-83" International Exhibition held in Moscow in the spring of this year. Industrial robots occupied a prominent place among the exhibits shown. Dozens of foreign firms, our own domestic enterprises and socialist states demonstrated many mechanical helpers for the most diverse

purposes -- robots which could machine parts, weld, transport, paint, assemble and do other operations. Such impressive demonstrations of all the possible automatic manipulators, and such an impressive demonstration of the broadest technological possibilities of these devices are especially remarkable because, only five years ago, nothing like that could be seen at any of the international exhibitions. Thus, we are dealing with an unusual phenomenon: the swift creation of a new industrial sector -- robotbuilding.

At present, about 7000 robots are in operation in our country (of those, over 2000 are in enterprises of this ministry) and their number is increasing very rapidly. By the end of the five-year plan period, there will be tens of thousands of automatic manipulators. Designs are being improved and their area of application is being expanded. Our sector has made a considerable contribution to this important matter.

The first robot and manipulator sets appeared in instrument making plants about ten years ago. It is remarkable that from the very start these were devices of a very high class: they were entrusted immediately with very fine and complicated technological operations: assembling watches. The Petrodvortsovyy Watch Plant was the first to use robots. Then, robots also appeared at other related enterprises. At present, the watch industry has entire robotized shops. The participation of robots is very appreciable in manufacturing electromechanical devices, thermal regulators for refrigerators and many other products.

What is the economic effect of using robots? As a rule, it is very great. By using robots, the productivity of labor has more than doubled in assembling watches and tripled in assembling thermal regulators. Moreover, the introduction of robots usually raises the quality of the products. Thus, the reliability of thermal regulators increased by 1.5 times.

I will add that the effect of robotization is demonstrated, so to speak, not only in the direct form. Robots do not require housing, a seat in the plant dining room; it is unnecessary to build clubs, day nurseries, etc. for them. They are capable of working in gas polluted media, near red hot furnaces, and moreover, for three shifts. Robots are efficient and advantageous even when they are inferior to human workers in productivity, or the calculation of their economic effectiveness does not promise large immediate advantages. But these advantages will certainly appear and will be very great if the final national economic result and the social effect are taken into account. We can say without exaggeration that large scale introduction of robots is the demand of the times and the objective requirement of the modern stage of scientific technological progress, the reflection of the urgent requirements of economics, a reliable means for raising the attractiveness of labor and easing it.

All this prompted us to create and energetically implement that specific comprehensive scientific technological program to develop, manufacture and introduce robots in the period up to 1986. This program was included in the general plan to reequip the sector and became, essentially, its core.

Basically, its pursues four goals: the development of the scientific technological potential of the sector up to a level that would make it possible to satisfy our own needs in new robot developments; creation of an industrial sector of robots; training receptivity to robotization in the collectives of the enterprises; the introduction, before the end of 1986, of not less than 30,000 automatic manipulators at instrument making plants and associations, this being only the first large step on the road to the robotization of the sector.

Thus, the issue of the "Robotization program" for the sector. It is a booklet of 60 pages of closely printed text. It opens up with an order to the ministry in which problems are clearly formulated and workers responsible for the realization of each part of the program are specifically named. Then follow tables. Many tables. These are tasks of all-union industrial associations and enterprises. Here may be found answers to practically all questions related to the realization of the program.

Who will design the robots? The basic load will fall on the Scientific Research Design Technological Instrument Making Institute (NIItekhnopribor) in Smolensk. The general scientific technological guidance for introducing robots was entrusted to the Moscow "Temp" Scientific Production Association. Moreover, individual specialized and comparatively little-distributed robot types will be developed in nine other institutes and design bureaus of the sector in Leningrad, Riga, Yaroslavl', Gomel' and other cities.

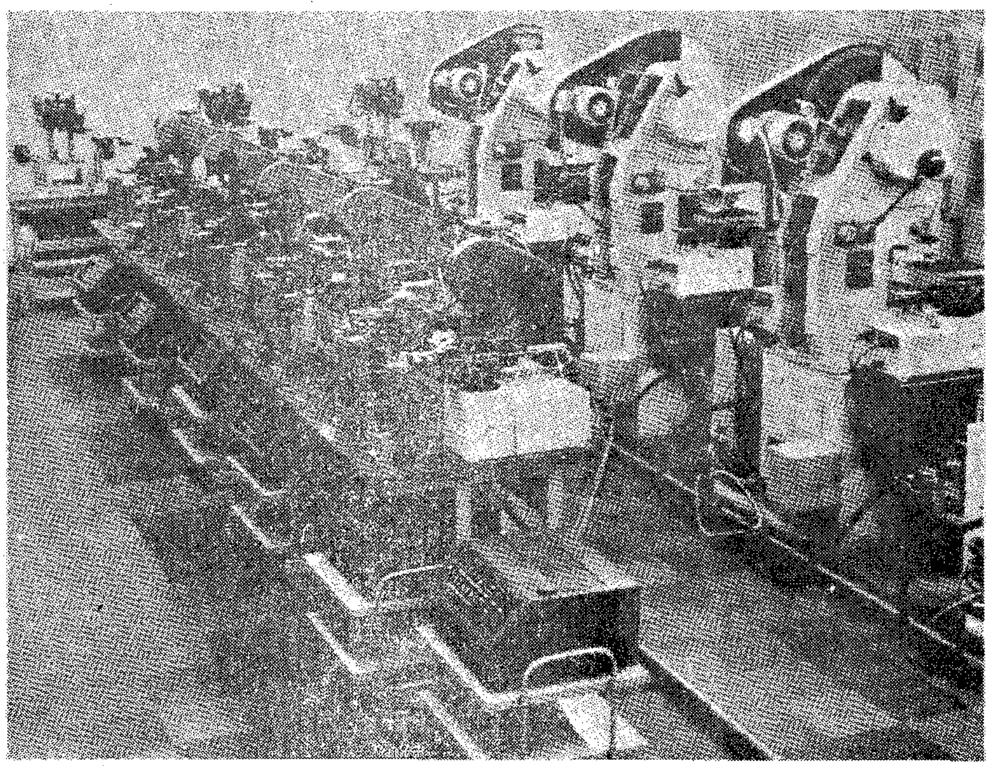
The central part of the program is probably the one that determines where the robots will be manufactured and how their production will be organized.

Only recently there were no robot building plants in the sector. Only two years ago three-fourths of the total number of robots made in this ministry were manufactured by watch plants and also introduced in the watch plants.

During the five-year plan period, series production of robots will be organized in this sector at a number of specialized plants. The largest of them, the Ramenskiy and Mogilevskiy, are rated to manufacture 2000 robots and manipulators annually each. The first lots have already been produced. The robots will also become the main product for the "Soyuztekhnopribor" All Union Association. All plants in this VPO [All Union Production Association] will manufacture over 7000 robots in 1986. Over 6000 will also be made by the watch industry.

The planned increase is impressive. It will not be easy to achieve. We think one important circumstance will help. Robotbuilding plants will not start operating singly. Actually, they will be assembly enterprises and the most important robot units will be supplied to them by tens of other plants in the sector.

There are six pages of tasks in the "Program" assigned to many instrument-making collectives. We consider this the correct approach. You wish to get reliable helpers, assistance in production, save hundreds of thousands and even millions of rubles -- make your contribution to the implementation of the robotization program.



Robotized line for the production of microcircuits (Leningrad "Elektronpribor" Production Association).

However, this program is far from being limited to expanding the output of automatic manipulators. We are talking about a reorganization considerably more multifaceted and complicated: about changing the psychology of people -- managers and ordinary workers, their attitude toward technical progress and toward automation of production. Robotization raises the work done in this direction to a new, qualitatively higher level.

I will clarify this thought in the following manner. If a worker discovers that two parts do not couple properly when being assembled, he can clean and correct something manually, remove burrs, etc. A robot cannot be trained to do this -- it must be fed only parts of excellent quality, and this should be done regularly, strictly according to schedule. This means that the introduction of robots demands a different, higher standard of production and control. The robotization program specifies a number of measures in this regard. The problem is posed as follows: train people, first of all production managers, to work with a large park of automatic equipment and its servicing; adapt the entire organization of labor to today's highest stage of automation -- robotization of production. How can this problem be solved?

Geographically, our enterprises are distributed quite widely in the country. They can be found practically in all industrial regions. Yet, there are also several "constellations" of instrument making plants. There are about 10 of them in Leningrad, about 8 in and near Kiev, the same number in the Baltic region and 12 in the Volga region. Each cluster also has one or two collectives which began earlier and succeeded more than the rest in introducing robots and thus accumulated some experience in this new to the basic group of instrument-making business. They were assigned as kind of robotization centers -- each in his own region.

What are the role and problems of these centers?

Let us take, for example, the Smolensk center headed by S. P. Kronshtofik, director of the NIITekhnopribor. Institute specialists conducted investigations of all instrument-making enterprises in the cluster and identified sections and work positions where it is expedient to use robots, as well as determining the sequence of the work. Then, they helped plants staff groups of specialists who are now introducing and operating automatic manipulators. At the Smolensk interindustrial territorial center of scientific technological information and propaganda, a consultation place was equipped where engineers and managers of other enterprises, even if they report to different ministries, are given advice and recommendations on the problems of introducing robots. Many show interest in the activity of the center. Close relationships were formed by specialists of Orsha "Legmash" Plant. Manufacturers of sewing machines, as was found, also need robots and they consider that in this area cooperation with instrument makers will help them solve many problems.

Special attention should be given to this last side of the territorial center's activity. The "Regulations" for this center, approved by the Minpribor board, contain the following points: "The problems and duties of the center includes the organization of direct communications with enterprises and organizations of other industrial sectors for the purpose of obtaining and introducing manipulators." This point is being successfully implemented in practice.

N. A. Tikhonov, member of the Politbureau of the CPSU Central Committee, Chairman of the USSR Council of Ministers (center) and L. A. Kostandov, Deputy Chairman of the USSR Council of Ministers (to the right) inspect the TUR-10 robot. Explanations are given by M. S. Shkabardyan, Minpribor Minister; at left of picture is I. D. Goloto, chief engineer of the "Soyuztekhnopribor" VPO and scientific manager of the robotization problem in instrument building.

When a conference of Minpribor specialists dedicated to the further acceleration of technical progress was recently held in Orel, the party obkom invited managers of other Orel enterprises. We persistently call upon our directors to visit more frequently the collectives of those industrial sectors which achieved successes in the robotization area, borrow their experience and learn to work with manipulators.

Here the following problem is posed: not only to adapt existing production facilities to introducing and utilizing robots, but to design and later create in practice robotized production facilities, especially those that from the very beginning are intended for operation with automatic manipulators. Precisely this course, as shown in practice, is the most efficient and precisely this approach promises the greatest economic gain. When we now speak about

the creation of a flexible technology and unmanned shops, we speak exactly about production facilities which cannot operate without robots and manipulators inserted organically in the technological circuit.

Still another important innovation: the creation of a robot chief designer institute. In the broad and branched industrial sector of robot equipment and robot technology, there are 14 directions and specialists are appointed who are responsible for the creation and introduction of automatic manipulators for each of these directions. By the way, personal responsibility and specialization of engineers are especially needed here. Robotization is a fine specific thing and it is necessary that there be people in each collective that work on them and nothing else. There are such people at present at almost all plants of this industrial sector. Special robotization bureaus were formed at many of them. At some places, they appeared not without difficulty and not without resistance on the part of individual managers. They said -- why is such a subdivision necessary? -- in fact, the plants already have bureaus and departments of mechanization and automation.

True, there are. There was one, for example, in the Leningrad "Vibrator" Association, one of the leading ones in the industrial sector. Yet, things were not well with robotization here and manipulators were introduced slowly and reluctantly. The reason was, in fact, not a lack of desire or low skills of the engineers. Simply, the forces of the engineers were scattered in many directions and none was left for the manipulators. While they created a robotization bureau, only 12 robots appeared in association's shops in one year...

Not all managers of our plants were fired up immediately with a desire to implement the robotization program more rapidly. To change this frame of mind, a number of additional incentives were put in operation in the sector for enterprises and individual workers who introduce robot technology energetically. Say, starting with last year, workers and specialists who design, manufacture, introduce robots and service them are paid a bonus whose size depends on the saving obtained during the year. On completion of large and considerably work in the area of robotization, their participants are given memorable gifts. The first such gifts, inscribed watches, were given to the engineers of the Orel "Prompribor" Association -- creators of the robotized production of thermal regulators.

A year-and-a-half has passed since the industrial robotization program was adopted. It is being basically implemented successfully and everything that was planned for this period was done. However, there were identified unsolved problems and we came up against a number of difficulties. There are not enough small electric motors, specially designed for use in robots; they are being manufactured by industry in extremely limited quantities. Robot creators need hydraulic units and components acutely. So far, they are being manufactured in a clearly insufficient volume.

Of concern also is a lack of interindustrial standardization of robot design. They are produced at present by enterprises of various ministries and, having solved the standardization problem, it should have been possible to organize mutual cooperation between enterprises of various industrial sector, and establish the manufacturing of many robot components on conveyors.

I want to stress that we are solving some of these problems with out own forces. Thus, a greater part of robots manufactured by plants of our sector is based on the so-called modular principle. In other words, manipulators for various purposes can be assembled from a small number of component modules. This is convenient and advantageous to those who operate robots and to those who produce them.

At the same time, in preparing our sector robotization plans, we try as much as possible not to duplicate collectives subordinated to other ministries. We try as much as possible not to make what is manufactured by others; we exchange various automatic devices with enterprises of other industrial sectors, in particular, with plants and associations of the automobile and electronic industries. This accelerates solutions of problems of the comprehensive automation of instrument-making plants and associations.

Essentially not much time, slightly over three years, remains until the end of 1986 when our robotization program should be completed. It is asked frequently; what further will be the following steps in the robotization of this industrial sector?

We think that 30,000 robots and manipulators at over 200 plants -- this, certainly, is not small. But this is still far from the maximum robotization level. We intend to go farther in creating robot technological complexes that represent sets of equipment created for working " in harness" with robots. An important place in our plans is occupied also by flexible automated production facilities (GAP), in whose creation at present scientific research, planning design and production collectives of this industrial sector are strongly involved. Equipment of this kind, by the way, was also demonstrated and evoked great interest at the previously mentioned "Avtomatizatsiya-83" International Exhibition. Next in turn also are robots of the following generations -- more complicated, intended for performing finer and more responsible operations, self-learning, capable of discriminating graphic symbols, and reacting to sound signals and the human voice.

Briefly, in the visible future, a new industrial sector of robotbuilding will begin to grow and develop at a high rate. Robot equipment and robotbuilding which are beginning to be born at present, literally before our eyes, are fated to play an important role in easing the labor of many thousands of people, in technical progress and in multiplying the economic power of our Motherland.

2291
CSO: 1823/70

OPERATIONAL FEATURES OF FOUR NEW SOVIET ROBOTS DISCUSSED

Moscow NAUKA I ZHIZHN' in Russian No 10, Oct 83 pp 7-10

[Article: "Parade of Robots"]

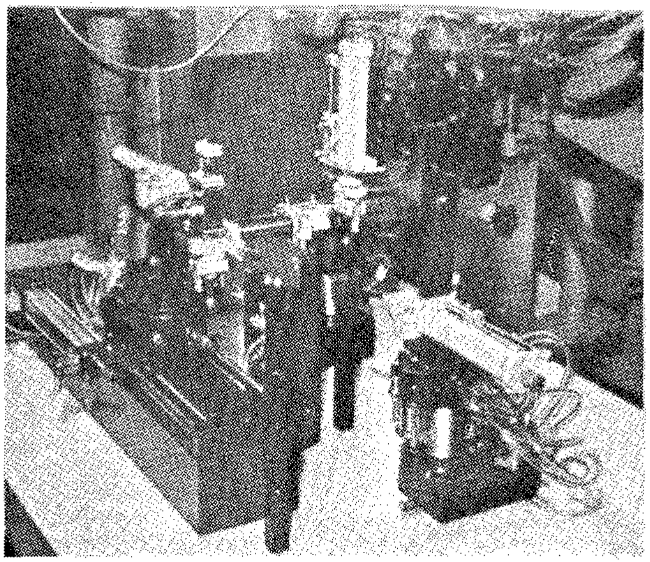
[Text] Robots occupied one of central places in the exposition of the majority of the countries participating in the "Avtomatizatsiya-83" Exhibition. Several of the technological robot sets created by our specialists and demonstrated at the exhibition have already been described by NAUKA I ZHIZN' (No 9, 1983). Here we acquaint readers with four more exhibits: robots already being manufactured by domestic industry. In the next issue, the parade will be concluded by robots from abroad being demonstrated at this exhibition.

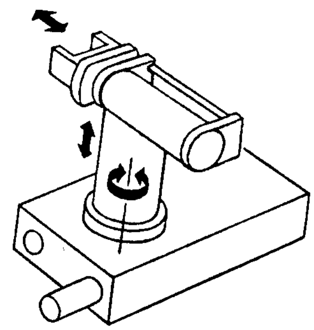
On the Modular Principle

Instrument making has a fairly large number of various technological operations that it would be desirable to turn over to robots. In particular, technological robot sets are very promising for assembling, welding and monitoring. However, it would, of course, be inexpedient to create its own specially adapted robots for each such set.

The NIITekhpribor [Scientific Research Design Technological Institute of Device Making] developed a modular equipment system for building PR5-2 industrial robots with pneumatic drives.

This system has five modules, each of which provides the robot with one degree of mobility; four modules implement linear movements and one--angular movement. Thus, from these modules, it is possible to assemble robots with the needed functional possibilities with a number of degrees of mobility from 2 to 5. In particular, PR5-2 robots, demonstrated at the "Avtomatizatsiya-83" (shown in the picture), were assembled with three modules each.





PR5-2 robots (each assembled of three modules and correspondingly has 3 degrees of mobility); the kinematic arrangement is given for the case when two modules implement linear movement and one--angular movement and, therefore, the manipulator operates in the cylindrical system of coordinates.

The PR5-2 robots are operated in the cyclic mode by a programable controller or cam signaling device. In the latter case, the robot is controlled as follows. On the shaft of the signaling device, driven by an asynchronous motor, the cams are preliminarily set in such a way that as the shaft turns, they open and close valves of the pneumatic distributor in a sequence that implements the working program. The modules move from stop to stop in all degrees of mobility. The positioning error does not exceed 0.15mm. The speed of linear movements is 200mm/second and of the angular movement--180^{o}/second. The PR5-2 robot can operate in the rectangular or cylindrical coordinate systems; in the latter case, to move the clamp to the required point in space, arm movements "up-down," "forward-back" and turns around the axis are combined. The lifting capacity of the robot is 320 grams.

The modular system created to design robots was found to be very efficient due to its universality, the large number of arrangement versions, small size and weight, simple servicing, reliability and low cost. At the "Avtomatizatsiya-83" Exhibition, for example, several technological robot sets using PR5-2 robots were demonstrated (about two such sets in NAUKA I ZHIZN' No 9, 1982).

Universal Robot

The TUR-10 can do many things. It can perform successfully such basic technological operations as, for example, welding, assembling, cleaning burrs or can do auxiliary work like servicing automatic equipment, including machine tools with numerical control, loading and unloading parts and intermediate products. The TUR-10 can be used in automatic lines, and flexible automated production facilities. In short, it is capable of doing many things and is universal (the TUR is an acronym for technological universal robot and the number 10 is its load lifting capacity in kilograms).

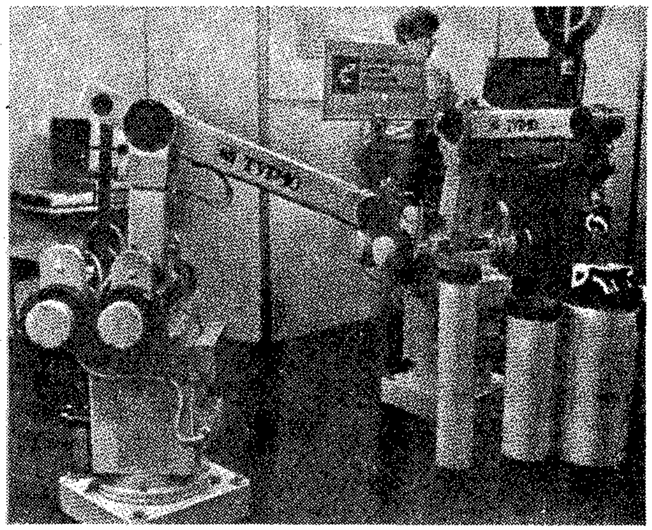
The robot's universality provides high mobility of its manipulator and movement control system corresponding to it. The manipulator (it has five degrees of mobility) is an arm in the form of articulated links, installed on a rotary platform. They are moved by DC electric motors through wave reducers. We used such reducers in series produced robots for the first time. A wave reducer has a large gear ratio (1:100) for relatively low size and weight; almost half of all its teeth are engaged simultaneously, which provides a gearing with practically no air gaps. The position of hinges is tracked by coded high resolution photoelectric sensors, while the speed of the motors is tracked by AC velocity generators. Data from these sensors is transmitted over a feedback circuit to a numerical control device and to the electric drive control device. All this guarantees high positioning precision-deviations of the grip center from the given coordinates do not exceed 0.2mm. Each manipulator link can only turn around its axis and all together can turn around the axis of the platform. To obtain the necessary final linear movements, it is necessary to have an interpolator which will calculate the coordinated movements of the links and produce the control instructions to the drives.

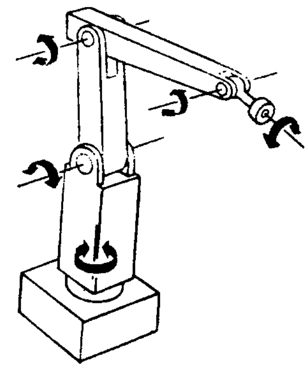
The drives of all manipulator links are standardized and increases its suitability for industrial production and simplifies its manufacture.

Depending upon its purpose, the robot will be used with positional or contour control systems.

The positional system is used when the robot must perform basically auxiliary operations of the "take-place" type. In these cases, the program determines the coordinates of the points in space in which the grip of the manipulator must be located in sequence. In this case, the trajectory between the destination points is not monitored by the system and the only criterion for it is time: a minimal path is selected. In the contour control system, where the working tool of the robot, say, a welding head must be provided with a continuous movement along a certain projectory that repeats the configuration of the product being welded, two points are given -- of the start and end of movement, and the shape of the curve between them. This program is implemented in the operating process by the interpolator and the tracking system.

The robot is trained and the program of its following activity is prepared by manual control from a panel.





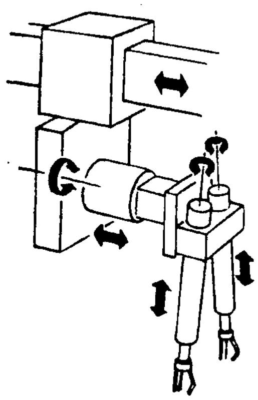
Adaptive technological robot set with a viewing system; TUR robots in the set have five degrees of mobility.

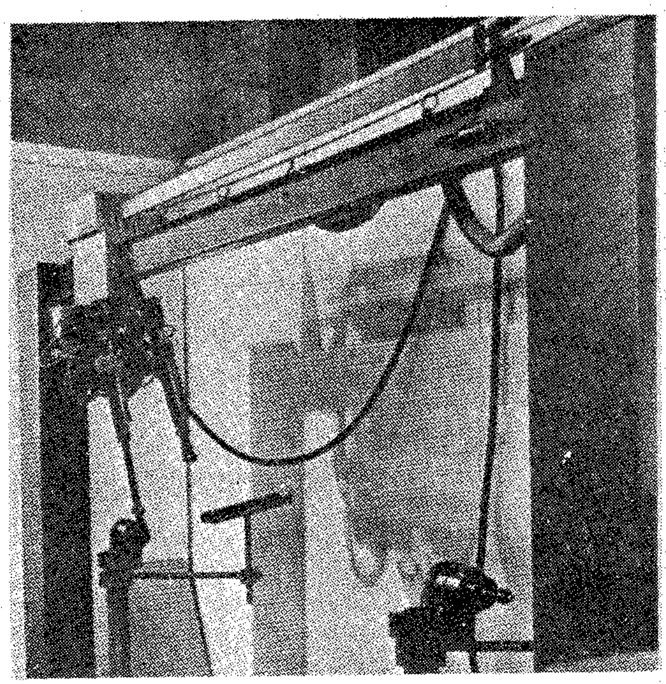
The contour control system is designed to use the "Elektronika-60" microcomputer. A special problem-oriented language which simplifies communications with the robot was created to ease the work of the operator.

Series production of the TUR-10 robots, created by the Smolensk NIITekhnopribor' was begun recently by the Mogilev "Tekhnopribor" Plant.

Machine Tool Operator Robot

The RF-204M industrial robot was created for the automation of auxiliary operations in loading turning machine tools with universal control and semi-automatic machine tools when operating in the composition ofmodules of flexible production facilities. The unusual thing in its design is that the manipulator has two arms with a lifting capacity of 1kg each. The purpose of this solution is simple: when the robot approaches the machine tool to remove the machined part with one arm, its other arm already holds the next in turn intermediate product which it will place immediately in the machine tool. The robot does not need to return an extra time to the magazine for the intermediate product and the idle time of the machine tool is reduced.





RF-204M robot. At the top of the picture can be seen the copper strip which is an unrolled winding of a asychronous motor; on the I-beam at right can be seen the sensor of the end position of the two-arm manipulator which has 8 degrees of mobility, not counting the grip.

In a nontraditional way, the problem of moving the manipulator with intermediate products and parts from machine tool to machine tool or from the machine tool to the magazine and back is also solved. The manipulator is

mounted on a transporting device which is a cart that includes an I-beam with a copper strip stretched over it. This strip serves as an unrolled winding of a linear asynchronous motor and creates a traveling magnetic field that moves the mobile part of the motor mounted in the cart. The lifting capacity of such a device is up to 40kg. The manipulator is assembled of modules which makes it possible to arrange it in accordance with requirements of a specific technological process. The drive of the manipulator operating in the cylindrical system of coordinates is pneumatic; the program control system is cyclic. All actuating manipulator links operate on rigid supports in which (besides the grip) sensors are built in the end position; hydraulic dampers are mounted on the corner of the module.

Positioning precision is very high: deviations from programed coordinates are not greater than 0.05mm.

Work programs are formed in the process of training by trial movement which is done manually on instructions from the control panel.

"KONTUR"

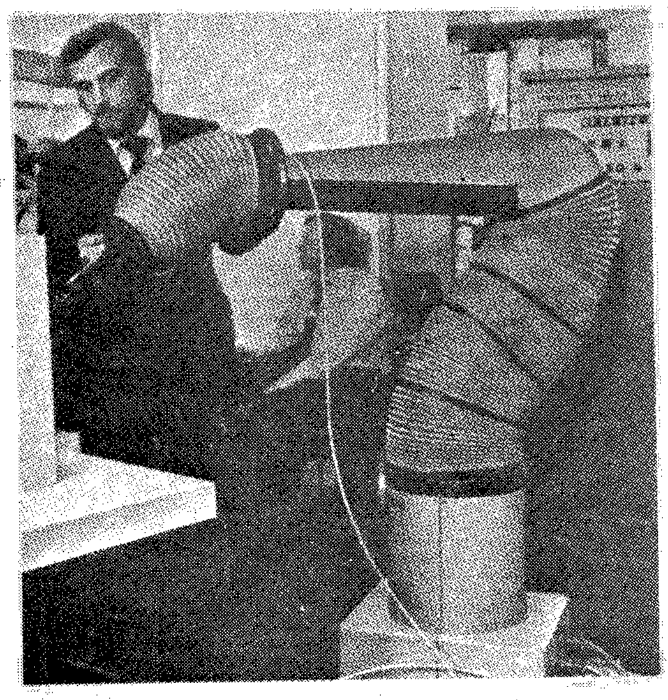
The very name of the robot indicates fairly clearly the nature of operations for which it was created. This is continuous movement of the working tool along the contour -- along the given trajectory. Depending upon which specific tool is attached to the robot arm, it can paint and varnish, grind complex configuration surfaces, sandblast or shot-blast or service casting machines. Such heavy, monotonous work is harmful and dangerous not only to man but also even to the robot. Therefore, links of its arms had to be covered with jackets to protect the mechanism from paint, molten metal and sand. Special measures for protecting against sparks make it possible to use the "Kontour-002M" in hazardous explosion quarters.

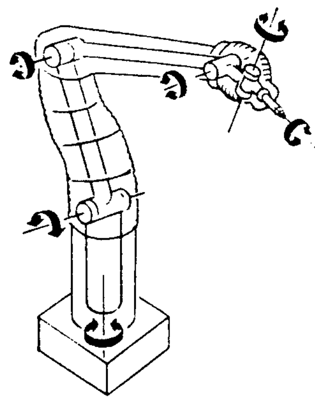
A special distinction of the "Kontour" is the design of its arm and the turning mechanism. Here so-called not fully revolvable hydraulic drives are used. With relatively small sizes, they develop a considerable torque, have a low friction coefficient and do not need reducers.

The execution of some production operation, say painting, is preceded by training the robot. The operator, taking it by the "trunk" -- the brush, moves it manually along the needed trajectory. Although the manipulator weighs 250kg, such a process does not require great physical effort. This is achieved by a spring system for balancing the weight of the arm links, by operation of hydraulic unloading valves and the special features of the hydraulic drives used.

Automatic recording (on flexible magnetic discs) is done during training. Later the program is monitored by a control system (Sfera-16"). It receives signals from sensors installed at all links of the arm and compares the data on the coordinates of the links in space to the data programed for a given moment in the training process. The results of the comparison are issued as instructions to hydraulic drives that control the movements of the robots.

The speed of the tool, whose weight may be up to 10kg, can be as high as 2 meters/second. The error in program reproduction does not exceed 3mm.





"Kontour-002M" electrohydraulic robot (in the picture is shown the moment when it is trained by the operator). The manipulator operates in the spherical system of coordinates and has six degrees of mobility with the rotary brush.

The "Kontur" robots are in operation at a number of enterprises in the country.

2291
CSO: 1823/71

PROBLEMS WITH THE INTRODUCTION OF ROBOTS IN ESTONIAN INDUSTRY DISCUSSED

Tallinn RAHVA HAAL in Estonian 30 Oct 83 p 2

[Article by Vello Reedik, docent in the machine building department of TPI (Tallinn Polytechnic Institute) and Andres Unt, department head of SKTB (Special Construction and Technology Bureau) Efekt: "Iron Men'" Are Coming Into Factories: In Our Republic Too First Steps Have Been Taken To Robotize Production." Passages in boldface printed in all caps.]

[Text] What Is An Industrial Robot?

Usually a first look at an industrial robot is disappointing, since it does not suit the images created by science fiction books and movies.

AN INDUSTRIAL ROBOT IS A UNIVERSAL, EASILY RETOOLABLE AND REPROGRAMMABLE MANIPULATOR THAT PERMITS AUTOMATION OF MANY OPERATIONS REQUIRING HUMAN-LIKE MOTIONS IN SERVING TECHNOLOGICAL PROCESSES. IT IS PRECISELY THE RETOOL-ABILITY AND FLEXIBILITY OF USE THAT MAKE THE INDUSTRIAL ROBOT DIFFERENT FROM THE WELL-KNOWN AUTOMATIC MANIPULATORS. MERELY REPLACING A MAN WOULD BE CONTRARY TO ONE OF THE BASIC PRINCIPLES OF AUTOMATION. AN INDUSTRIAL ROBOT IS TRULY EFFECTIVE ONLY WHEN ITS SPECIFIC CAPABILITIES EXCEED THOSE OF MAN.

Industrial robots have been applied in forging, stamping, and assembling functions, in servicing metalcutting tools, in welding, painting, transportation and loading, etc. It is particularly in limited production runs (and in developed industrial states about two-thirds of machine production involves small runs, with the ever accelerating scientific-technical revolution constantly reducing the useful life of products) where automatiion is impossible without flexible, rapidly reprogrammable systems in which programmed tools, automatic storage and transportation facilities, and industrial robots have been joined into a single unit by computer technology. Since such flexible production systems are still in their infancy, the industrial robot must initially be considered primarily an "iron worker," freeing humans from monotonous, difficult and unhealthy jobs. A robot's work is more reliable than that of man; it does not tire and can work day and night.

According to optimistic prognoses a robot can replace up to three workers, double labor productivity, and pay for itself in 1 to 3 years. In fact, things are not that simple: Placing a couple of robots in a plant has no

economic effect, a score of robots, competently installed, can already throw a nice profit, but incompetent procedures may mean that even a hundred robots cause a loss.

Experience shows that the intrusion of every new element into a developed production system is accompanied by:

Problems and Difficulties

Both for subjective and objective reasons. Perhaps the most important of the SUBJECTIVE HINDRANCES is the fact that the specialists concerned with installing industrial robots are not always able to grasp thoroughly and comprehensively all aspects of automation and often violate the basic principles of automation. An analysis of automated enterprises shows that 60 to 70 percent of the economic effect of automation comes from increased productivity, 15 to 20 percent from increased production, and only 10 to 15 percent from reductions in labor costs. There is no sense to expect economic effect from automation of isolated operations if the rest of the technological system remains unchanged. The most promising use of means of automation is where their application is unavoidable, not where they can somehow be adapted to existing conditions. An industrial robot needs very careful attention, both from management and servicing personnel.

AMONG OBJECTIVE DIFFICULTIES is foremost the still low reliability of industrial robots. There is also a lack of peripheral equipment and the irrational structure of the industrial robots currently in production.

The life of any new product, including that of industrial robots, follows the general pattern of idea-mockup-experimental model-funcational construction-economically feasible construction. The majority of robots currently in use has hardly passed beyond the experimental stage and it would be unrealistic to expect faultless functioning from them. It must also be remembered that the mere existence of industrial robots does not solve a single automation problem, since a robot is first of all blind and unfeeling, and secondly it lacks all the implements linking it to the general technological process, which, taken together, represent the so-called peripheral system. The production of those implements in place is not easy, it requires time and thus postpones a robot's application.

Industrial robots are generally not in short supply, but there is a shortage of robots for welding and painting tasks. There are also few industrial robots that can be used in other industrial branches besides machine and apparatus building. But there are enough simple and cheap robots for presses and metalcutting, and they should be used first to gain experience.

What is the situation regarding industrial robot use in:

Our Republic?

It can be said with satisfaction that lately the ice has been broken--production managers have begun to grasp one of the basic principles of automation, namely, that one should not be too tardy in applying promising ideas. Of

course, the opposite--excessive rushing and application of half-baked technical solutions--is also impractical. The ESSR Local Industry Ministry and the "Norma" collective have shown a very competent sense of perspective. It was deemed logical that all the birthing pains associated with robotization of production in the Local Industries Ministry system be suffered within one organization, namely the special construction and technology bureau "Efekt". From here the enterprises are to receive industrial models of researched and tested robotic complexes. The machinebuilding department of the Tallin Polytechnic Institute participates in this effort. TPI scientists were tasked with constructing a pneumatic system of sensors through which an industrial robot supervises the technological process and which is designed to protect the robot as well as the technical equipment from emergency situations.

The first robitic complex, consisting of a vibrobunker, a model 7605 industrial robot, and two presses, designed to stamp out the nob of automobile safety belts began production in the summer of 1982. This was a preliminary trial--currently work is underway on a much more serious task--putting together a robotic complex to make locking pins for safety belts.

The undersigned have learned that the implementation of a robotic complex is quite a tedious job, requiring trials, searches, and hard work.

The problem of industrial robot use is now investigated elsewhere in our republic as well, such as in the Tartu Apparatus Factory, the Tallinn Electrotechnical Production Collective imeni M. I. Kalinin, the Estonian Fishing Fleet Maintenance Production Collective, etc.

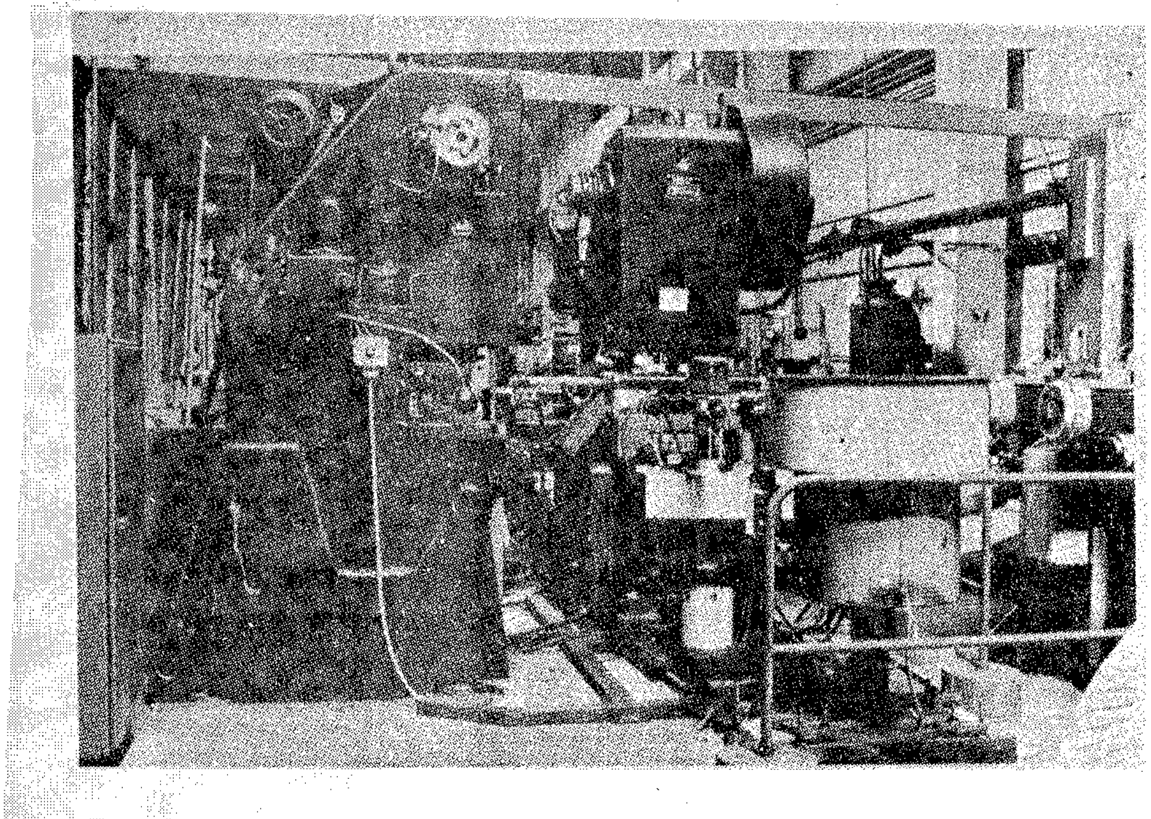
In order to train personnel needed for robot use, courses for computerized machine and industrial robot operators have started. In TPI robot-related instruction is provided even by two departments. An electrical engineer specializing in robots from the energy department, and a machine builder with similar training from the mechanical engineering department should between the two of them be able to solve all questions regarding industrial robot construction.

Two industrial robots for training purposes have been installed in the TPI, and a lecture series "What to do with industrial robots?" is also available. The first book in Estonian on the subject is ready for printing. The extremely necessary technological information is also on the required level--the VALTER automatic data system provides information on industrial robots.

Up to the spring of this year our republic lacked an institution that would coordinate the efforts of various agencies in the field of industrial robotics. Now a committee on programmed machines and industrial robots has been organized within the Council of Estonian Republic Scientific-Technical Societies that assists in the exchange of lessons learned, organizes lectures, courses, conferences, etc. For example, two republic-wide conferences have been scheduled for next year, the second of them totally devoted to industrial robots.

Plans call for TPI to offer next fall courses on programmable machines and industrial robots to engineering-technical personnel. There are also plans to learn about the experiences made with industrial robots in the fraternal republics. For example, seeking how a score of robots busily toil away in the Leningrad Electromechanical Factory under the careful eye of an operator even a skeptic will lose his reservations about the "iron workers."

In summary, it can be said that quite a lot has been done, but a great job lies ahead in raising the industry of our republic to a qualitatively higher technological level. In this industrial robots will play quite an important role.



An experimental robotic complex used in the "Norma" collective (above). Here a two-armed robot services two presses that cut and bend nobs for automobile safety belts. The startup of this complex was the first step taken in "Norma" toward production robotization, and as the article states, the use of one robot has no economic effect at all in the enterprise. But one person can service four of these complexes....

The control panel of the robotic complex.

9240
CSO: 1815/9

END